

CLAIMS

What is claimed is:

1. An oxidative dehydrogenation catalyst comprising
 - a non-copper base metal selected from the group consisting of metals of Groups 2, 4-7 and 11-13 metals of the Periodic Table of Elements, scandium, yttrium, actinium, iron, cobalt, nickel, their oxides and combinations thereof;
 - copper;
 - optionally, a promoter comprising a metal from Groups 8, 9, and 10 of the Periodic Table of Elements, and
 - a support comprising aluminum oxide, zirconium oxide, silicon nitride, magnesium oxide, or mixtures thereof;
 - wherein copper is present at between about 0.0001 and 10 weight percent of the total catalyst weight, and the catalyst has a molar ratio of copper to the base metal greater than about 1:10.
2. The catalyst of claim 1 wherein the molar ratio of copper to the base metal is between about 1:10 and about 1:2.
3. The catalyst of claim 1 wherein copper is present at between about 0.01 and 2 weight percent of the total catalyst weight.
4. The catalyst of claim 1 wherein the base metal comprises an element selected from the group consisting of manganese, chromium, gold, their corresponding oxides, and combinations thereof.
5. The catalyst of claim 1 wherein the base metal comprises manganese.
6. The catalyst of claim 1 wherein the promoter comprises an element selected from the group consisting of platinum, palladium, iridium, rhodium, ruthenium, or any combinations thereof.

7. The catalyst of claim 1 wherein the catalyst comprises a promoter metal, and the promoter metal is palladium, rhodium, ruthenium, or iridium.
8. The catalyst of claim 1 wherein the support is pretreated using a technique selected from the group consisting of heating, spray-drying, dehydrating, drying, steaming and calcining.
9. The catalyst of claim 8 wherein the pretreatment comprises heating the support at a temperature between about 1,000°C and 1,500°C for 0.5 to 10 hours at a heating ramp rate between 0.5 and 3°C/min.
10. An oxidative dehydrogenation catalyst comprising
 - between 0.05 wt% and 20 wt% manganese;
 - between 0.001 wt% and 10 wt% copper;
 - optionally, between 0.005 wt% and 0.2 wt% of a promoter metal selected from the group consisting of palladium, iridium, rhodium, ruthenium, platinum, and any combination thereof; and
 - a support comprising zirconia, alumina, or combinations thereof.
11. The oxidative dehydrogenation catalyst of claim 10 wherein the catalyst comprises between 0.1 wt% and 2 wt% copper.
12. The oxidative dehydrogenation catalyst of claim 10 wherein the catalyst comprises between 2 wt% and 6 wt% manganese.
13. The oxidative dehydrogenation catalyst of claim 10 wherein the catalyst has a molar ratio of copper to manganese greater than about 1:10.
14. The oxidative dehydrogenation catalyst of claim 10 wherein the catalyst comprises a promoter metal, and the molar ratio of the base metal to the promoter metal is at least about 10.

15. The catalyst of claim 10 wherein the support is pretreated using a technique selected from the group consisting of heating, spray-drying, dehydrating, drying, steaming and calcining.
16. The catalyst of claim 15 wherein the pretreatment comprises heating the support at a temperature between about 1,000°C and 1,500°C for 0.5 to 10 hours at a heating ramp rate between 0.5 and 3°C/min.
17. An oxidative dehydrogenation catalyst comprising
manganese;
copper;
a promoter metal selected from the group consisting of palladium, iridium, platinum, rhodium, ruthenium, and combinations thereof; and
a refractory support.
18. The oxidative dehydrogenation catalyst of claim 17 wherein the catalyst comprises between 0.1 wt% and 2 wt% copper.
19. The oxidative dehydrogenation catalyst of claim 17 wherein the catalyst comprises between 2 wt% and 6 wt% manganese.
20. The oxidative dehydrogenation catalyst of claim 17 wherein the catalyst has a molar ratio of copper to manganese greater than about 1:20.
21. The oxidative dehydrogenation catalyst of claim 17 wherein the molar ratio of the manganese to the promoter metal is at least about 10.
22. The oxidative dehydrogenation catalyst of claim 17 wherein the refractory support includes a material selected from the group consisting of zirconia, stabilized zirconia, alumina, stabilized alumina, silicon nitride, magnesium oxide, and combinations thereof.

23. The oxidative dehydrogenation catalyst of claim 22 wherein the material is selected from the group consisting of zirconia, stabilized zirconia, alumina, stabilized alumina, and combinations thereof.
24. A method for making an oxidative dehydrogenation catalyst comprising
impregnating a base metal-containing precursor onto a support;
calcining said base metal-modified support;
impregnating a solution comprising copper and optionally a Groups 8, 9, or 10 promoter metal, onto said base metal-modified support to form a copper-modified catalyst precursor;
calcining said copper-modified catalyst precursor; and
reducing said calcined catalyst precursor to obtain a copper-modified catalyst.
25. The method of claim 24 wherein the copper-modified catalyst comprises between 0.001 wt% and 10 wt% copper.
26. The method of claim 24 wherein the copper-modified catalyst comprises between 0.005 wt% and 0.2 wt% of the Groups 8, 9, or 10 promoter metal.
27. The method of claim 24 wherein the promoter metal is palladium, iridium, platinum, rhodium, ruthenium, or any combination thereof.
28. The method of claim 24 wherein the support comprises zirconia, stabilized zirconia, alumina, stabilized alumina, silicon nitride, magnesium oxide, or any combination thereof.
29. The method of claim 24 wherein the copper-modified catalyst has a molar ratio of copper to base metal greater than about 1:20.
30. The method of claim 24, further comprising the step of pretreating the support using a technique selected from the group consisting of heating, spray-drying, dehydrating, drying,

steaming and calcining prior to the impregnation of the base metal-containing precursor onto the support.